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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/656,898	09/05/2003	Alexander Star	612407-2	1540

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EXAMINER

KUNZER, BRIAN

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 03/17/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

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<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/656,898	STAR ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	Brian Kunzer	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 10 January 2006.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-18 is/are pending in the application.
- 4a) Of the above claim(s) 13-18 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-12 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 05 September 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |                                                                                                    |                                                                             |
|----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)                        | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948)                | Paper No(s)/Mail Date. _____                                                |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>7/2/04</u> .                                                              | 6) <input type="checkbox"/> Other: _____                                    |

## **DETAILED ACTION**

### ***Election/Restriction***

1. Applicant's election without traverse of claims 1-12 in the reply filed on January 10, 2006 is acknowledged.

### ***Drawings***

2. New corrected drawings in compliance with 37 CFR 1.121(d) are required in this application because the drawings are informal and all of the features of the disclosed drawings are not readily apparent, especially in figures 1 and 2. Applicant is advised to employ the services of a competent patent draftsman outside the Office, as the U.S. Patent and Trademark Office no longer prepares new drawings. The corrected drawings are required in reply to the Office action to avoid abandonment of the application. The requirement for corrected drawings will not be held in abeyance.

### ***Claim Objections***

3. Claim 1 is objected to because of the following reason: The term "nanostructure" in claim 1 and in subsequent dependent claims is a relative term which renders the claim indefinite. The term "nanostructure" is not defined by the claim and the specification, while providing examples of nanostructure *devices* (i.e. nanotube sensors and transistors), uses indefinite language "such as" (see page 1, line 10 of Applicant's specification) and does not provide a standard for ascertaining the requisite degree of definition for the term "nanostructure." In other words, the term "nanostructure" can encompass virtually any structure on the nanoscale regime,

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0~999nm, and this term will be given its broadest limitation (including general VLSI MOSFET/CMOS structures) in the examination process unless otherwise defined by the Applicant. Appropriate correction or clarification by Applicant that does not introduce new matter will be considered.

4. Claims 9 and 10 are objected to because of the following informalities: Both claims recite the acronym PEI which is defined as polyethylimine in the specification; however the acronym is too ambiguous for the claims and it is suggested by the Examiner to replace the acronym PEI with polyethylimine for the sake of clarity. Appropriate correction is required.

#### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1, 4, 6, 8, 11, and 12 are rejected under 35 U.S.C. 102(b) as being anticipated by Gardner (USPN 6,111,280).

With respect to claim 1, Gardner teaches, from figs. 1a and 4a, a nanostructure sensor for sensing a target species, comprising:

at least one nanostructure (6);

at least two conducting elements (9 on either side of gate 11) in electrical communication with the at least one nanostructure (6);

a polymer layer (18) on the at least one nanostructure. (See column 3, lines 55-61.)

With respect to claim 4, Gardner teaches the nanostructure sensor wherein the at least two conducting elements (9) comprise metal electrodes. (See column 3, line 43.)

With respect to claim 6, Gardner teaches the nanostructure sensor wherein the polymer layer is selected to interact with the target species. (See column 5, lines 22-30.)

With respect to claim 8, Gardner teaches the nanostructure sensor wherein the polymer layer comprises more than one material. (See column 5, lines 35-40.)

With respect to claim 11, Gardner teaches, from fig. 1a, that the nanostructure (6) further comprises a gate electrode (11).

With respect to claim 12, Gardner teaches, from fig. 1a, the nanostructure sensor further comprising passivation material (14 and 12) covering regions in which there is electrical communication between the at least two conduction elements (9) and the at least one nanostructure (6).

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Claims 1, 2, 4-7 and 12 are rejected under 35 U.S.C. 102(a) as being anticipated by H.T. Ng's, "Flexible Carbon Nanotube Membrane Sensory System: A Generic Platform."

With respect to claim 1, Ng teaches, from fig. 3, a nanostructure sensor for sensing a target species, comprising:

- at least one nanostructure (CNT membrane);
- at least two conducting elements (gold Au and platinum Pt formed in steps B and B') in electrical communication with the at least one nanostructure (CNT membrane);
- a polymer layer (polydimethylsiloxane (PDMS) spacer or PDMS substrate (step A)) on the at least one nanostructure. (See p. 376-377)

With respect to claim 2, Ng teaches, from fig. 3 that the nanostructure (CNT membrane) formed in step C, includes carbon nanotubes.

With respect to claim 4, Ng teaches, from fig. 3, the nanostructure sensor wherein the at least two conducting elements (gold Au and platinum Pt formed in steps B and B') comprise metal electrodes.

With respect to claim 5, Ng teaches, from fig. 3, the nanostructure sensor wherein the at least two conducting elements (gold Au and platinum Pt formed in steps B and B') are in direct physical contact with the at least one nanostructure (CNT membrane).

With respect to claim 6, Ng teaches the nanostructure sensor wherein the polymer layer is selected to interact with the target species. (See abstract, p.375)

With respect to claim 7, Ng teaches, from fig. 3C, the nanostructure sensor wherein the polymer layer on the at least one nanostructure is discontinuous. (The PDMA substrate dots the CNT membrane nanostructure.)

With respect to claim 12, Ng teaches, from fig. 3, the nanostructure sensor further comprising a passivation material (PDMS slab and substrate in steps A and A') covering regions in which there is electrical communication between the at least two conduction elements (gold Au and platinum Pt formed in steps B and B') and the at least one nanostructure (CNT membrane).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ng's "Flexible Carbon Nanotube Membrane Sensory System: A Generic Platform."

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With respect to claim 3, Ng discloses all of the limitations of the nanostructure sensor except for specifically teaching the at least one nanostructure comprises a single-wall carbon nanotube (SWCNT) whereas Ng's device discloses use of multi-walled carbon nanotubes (MWCNT). However, Ng teaches that it is well known that SWCNTs are also extremely sensitive to chemical environments (p.375, 2<sup>nd</sup> paragraph). Therefore, it would be recognized by one of ordinary skill in the art, at the time of invention, that to replace the MWCNTs in Ng's sensor with SWCNTs would be obvious in light of the well known fact that SWCNT typically perform better than MWCNT, but are not as easily formed as MWCNT. (Also see ref. [V], p. 222, 2<sup>nd</sup> paragraph.)

7. Claims 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ng's "Flexible Carbon Nanotube Membrane Sensory System: A Generic Platform," as applied to claim 1 above, in view of Buckley (USPN 5,674,752).

With respect to claim 8, Ng teaches all the limitations as stated above.

Ng does not specifically teach that the polymer layer (PDMS) comprises more than one material.

However, Buckley, drawn to polymer-coated fibers for use as a chemical sensor, does teach, from column 5, lines 1-23, multiple polymer materials being coated on to a single fiber.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have the device of Ng, featuring more than one polymer material as disclosed by Buckley, since this added feature would allow for more selectivity of different or combinations of target chemicals. (See column 5, lines 16-23.)



With respect to claim 9, Ng teaches all the limitations as stated above.

Ng does not specifically teach that the target species comprises ammonia – although, ammonia is a well-known target for CNT sensors (see ref. [V], p.237) - and the polymer layer is polyethyleneimine (PEI).

However, Buckley, drawn to polymer-coated fibers for use as a chemical sensor, does teach, from fig. 10, the use of PEI as an ammonia sensor.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have Ng's nanostructure sensor device use PEI as the polymer over-layer since this material was known to detect ammonia and it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

8. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ng's "Flexible Carbon Nanotube Membrane Sensory System: A Generic Platform," as applied to claim 1 above, in view of McGill (USPN 6,320,295).

With respect to claim 10, Ng teaches all the limitations as stated above.

Ng does not specifically teach that the target species comprises hydrogen – although, hydrogen is a well-known target for CNT sensors (see ref. [V], p.237, fig. 14) - and the polymer layer is polyethyleneimine (PEI).

However, McGill, drawn to chemical sensors, does teach, from column 7, lines 15-19, the use of PEI as an hydrogen sensor.

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have Ng's nanostructure sensor device use PEI as the polymer over-layer since this material was known to detect hydrogen and it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

9. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ng's "Flexible Carbon Nanotube Membrane Sensory System: A Generic Platform," as applied to claim 1 above, in view of Lieber (USPAN 10/020,004).

With respect to claim 11, Ng teaches all the limitations as stated above.

Ng does not specifically teach that the nanostructure further comprising a gate electrode.

However, Lieber, drawn to nanosensors, does teach, from fig. 4a, a nanostructure sensor that comprises a gate electrode (backgate).

Therefore, it would have been obvious to one of ordinary skill in the art, at the time of invention, to have Ng's nanostructure sensor device include a gate as disclosed by Lieber whereby, "the backgate can be used to inject or withdraw the charge carriers from the nanowire. Therefore, it may be used to control the sensitivity and the dynamic range of the nanowire sensor and to draw analytes to the nanowire." (Paragraph [0145])

#### ***Pertinent Prior Art***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. H. Dai's "Carbon Nanotubes: Opportunities and Challenges" provides a background

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of carbon nanotubes (CNT) and their applications and section 5.2 (p. 235) is especially useful for providing information that was known about CNT chemical sensors at the time of applicant's invention. Also figs. 1-6 of U.S Patent 6,346,189 to Dai discloses carbon nanotubes between two conductors, but does not disclose a polymer on the nanostructure.

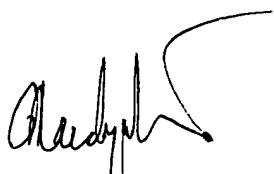
### *Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian Kunzer whose telephone number is (571) 272-5054. The examiner can normally be reached on Monday-Friday 8:00-4:30 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (571) 272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BK  
3/3/2006



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PRIMARY EXAMINER